DISTRIBUTION AND ECOLOGICAL CHARACTERISTICS OF IRONWOOD, *OSTRYA VIRGINIANA* (MILLER) K. KOCH, IN NORTHEASTERN NOVA SCOTIA

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ABSTRACT

Ironwood, *Ostrya virginiana* (Miller) K. Koch, an Alleghanian species, reaches the northeastern limit of its range in northern Nova Scotia. The species is in a vigorous condition and widely distributed in the region, but normally reflects low density of stocking. Notable silvical characteristics of ironwood in northern Nova Scotia include high tolerance, wide ecological amplitude, vitality and aggressiveness.

Key Words: Ironwood, Nova Scotia, range limit, ecological amplitude, density

Ironwood, *Ostrya virginiana* (Miller) K. Koch, is one of a number of tree species, mainly of Canadian or Alleghanian affinity, which reach the northeastern limit of their ranges in northern Nova Scotia. Other taxa reflecting this pattern of distribution include *Populus grandidentata*[1], *Quercus rubra* var. *borealis, Acer saccharum, Fraxinus americana* and *Tsuga canadensis* (Little, 1971; Scoggan, 1978.)

Available information suggests the possiblity of considerable differences in local distribution, abundance and habitat-selection in northern Nova Scotia among elements of the foregoing complex of species (Roland and Smith, 1969). Accordingly, studies were initiated with the object of gaining detailed information on the occurrence, importance and ecological relations of Canadian-Alleghanian species in the region. Observations on *Acer saccharum* have been published previously (Greenidge, 1977). The purpose of the present paper is to describe and discuss the local distribution and silvical characteristics of ironwood over a broad range of sites in the northeastern region of the Province.

METHODS

Field work was concentrated in topographically-diverse areas of Nova Scotia bordering the southern reaches of the Gulf of St.

[1]Nomenclature follows Fernald (1950)

Lawrence (Figure 1). This region suffered extensive Pleistocene glaciation (Prest and Grant, 1969). However, the possibility of the existence in late-Wisconsin time of upland and coastal refugia has been recognized by Grant (1977).

Extensive new collections of ironwood were made to increase knowledge of its distribution in northen and northeastern Nova Scotia[2]. Reconnaissance and intensive surveys, transects, line (strip)-cruises and sample plots were used to investigate the occurrence, density, morphological characteristics, habitat preferences, crown-class relations, tolerance, associated species, vigor, successional tendencies and reproductive potential of ironwood over a wide spectrum of sites.

Observations were made both in forested and partially-forested areas of the region, with emphasis on conditions in the closed forest. Transects utilized to investigate the occurrence and field-relations of the species on topographically well-defined sites were oriented at right angles to the contours on hill-slopes, and along the axes of spurs, stream-hollows and valley-heads. Surveys and searches were employed for the same purpose on sites of limited topographic variability, including upland-surfaces, terraces and bottom-lands. Quantitative data on density (trees per acre), dominance (basal area per acre) and stand-composition were accumulated with the aid of strip-cruises and sample plots.

RESULTS

DISTRIBUTION. Figure 2 illustrates the pattern of distribution of ironwood in Nova Scotia. This map incorporates information on collections housed in several herbaria: ACAD, DAL, NSPM, NSAC, UNB, GH, CAN, and DAO. Also included in Figure 2 are the results of the author's collection of ironwood in the Gulf of St. Lawrence-Cabot Strait area of Nova Scotia.

With specific reference to northeastern Nova Scotia, a study of available collections suggests that the species becomes less frequent northeastward. Thus far, ironwood apparently has not been collected north of the Cheticamp River watershed, and no collections of the species from Victoria and Richmond Counties are

[2]These materials have been deposited in NSPM.

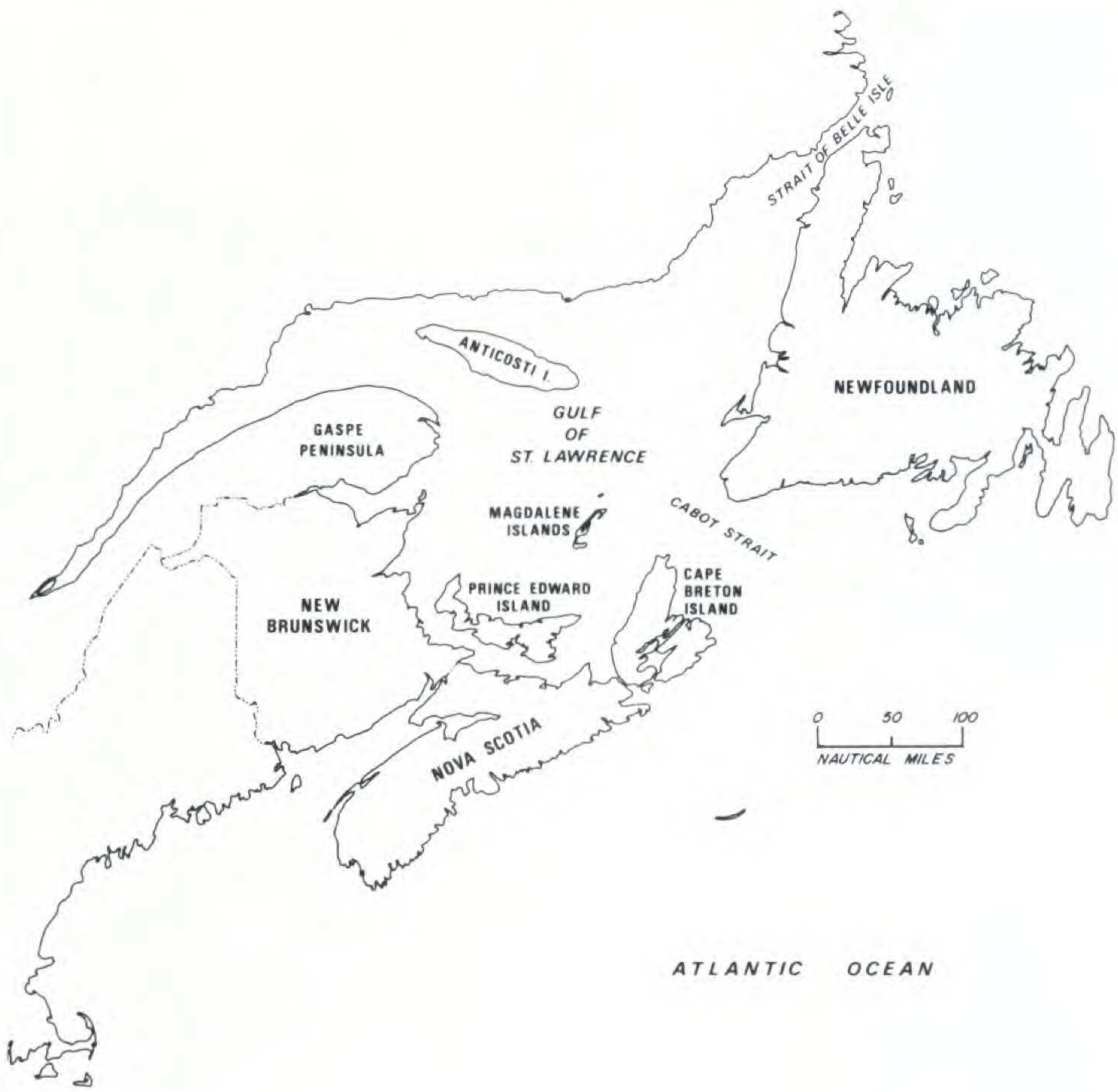

Figure 1. Map of the Gulf of St. Lawrence—Atlantic Provinces Area of Eastern North America.

known to the author. However, a report by Bulmer and Hawboldt (1958) treating the forest resources of Nova Scotia noted the occurrence of ironwood in both of the above-mentioned counties.

OCCURRENCE AND HABITAT PREFERENCES. In areas of discontinuous or partial forest-cover in northern Nova Scotia, ironwood occurs as scattered individuals or in small concentrations in riparian stands and thickets, along roadsides and the edges of fields, and in cut-over areas, power-line clearings and similar types of disturbed sites.

In forested areas of northern mainland Nova Scotia, the species exploits a broad range of sites, and reflects modest, occasionally considerable, abundance in light soils on the variable topography immediately south of the Gulf of St. Lawrence. Scattered indi-

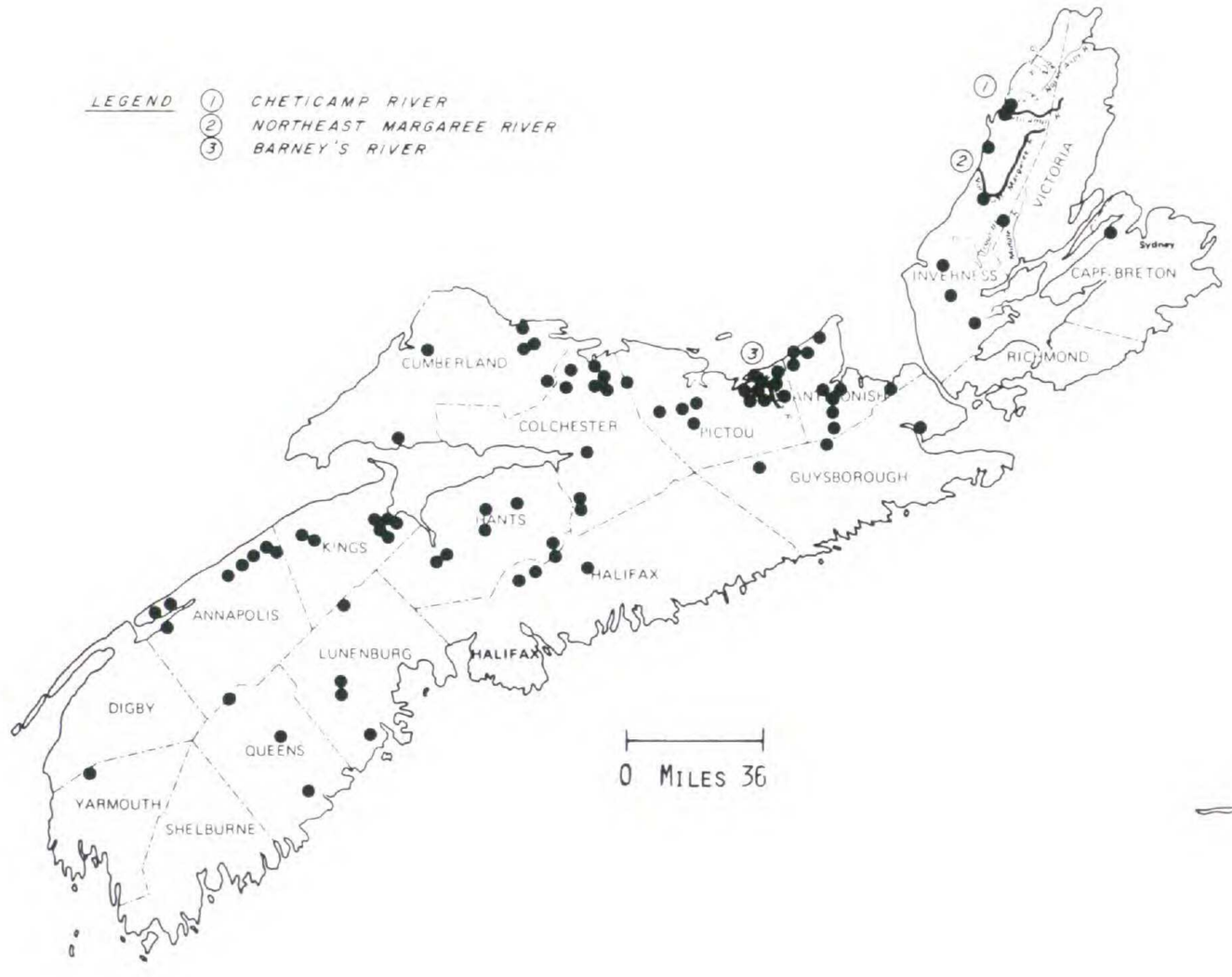

Figure 2. Distribution of *Ostrya virginiana* in Nova Scotia.

viduals or occasional small concentrations of the species occur on saddles and upland-surfaces to elevations of approximately 750 feet. The species also occurs on the flanks, axes and toes of spurs, on valley-side slopes of all exposures, on flood-plains, on outwash and alluvial-terraces, and on low, protected, off-shore islands in the lower Barney's River region of Pictou County.

The species is uncommon on lowland sites in the region marked by the presence of heavy, fine-textured soils.

To the northeastward, on the approaches to the limit of its range in Cape Breton Island (Figure 2), ironwood continues to demonstrate modest ecological amplitude. The species is scattered and infrequent in the topographically-varied, forested landscape of the lower Cheticamp River, occurring on flood-plains, alluvial-terraces, spurs, and saddles, and on east, southeast, south, southwest and west-facing slopes. South of the Cheticamp River, in the Margaree watershed, the species has been collected on forested alluvial-terraces and in meadow thickets.

DENSITY AND STAND RELATIONS. Ironwood generally constitutes a secondary species in contemporary forests of northern and northeastern Nova Scotia. The species is found very rarely in old-growth forests, infrequently in disturbed or deteriorating older stands, and more commonly in young, disturbed or undisturbed, hardwood and mixedwood forests. Density commonly is low, with somewhat higher levels of stocking evident in upland areas of northern Pictou and northernmost Antigonish Counties, and north-central Colchester County.

Occasionally, however, ironwood reflects considerable abundance over limited areas in northern Nova Scotia, and achieves locally the status of a primary species. Illustrations of this tendency toward greater densities are presented in Tables 1 and 2. These tables summarize results obtained from sample-plots established in northern Pictou County for the purpose of documenting high densities of stocking in ironwood and to indicate its ecological tolerance. Attention is invited to the occurrence and abundance of ironwood on the alluvial-terrace in association with relatively intolerant pioneer species, and to its considerable presence on the upland-surface in combination with long-lived, tolerant species.

MORPHOLOGICAL FEATURES. In the closed forests of northern Nova Scotia individual ironwood trees may reach diameters at breast

Table 1. Composition, density and basal area (BA) relations in a 0.1 acre plot established on an alluvial-terrace on the lower reaches of Barney's River, Pictou County, Nova Scotia.

Species	Ironwood No.	Ironwood BA(ft.²)	W. birch No.	W. birch BA(ft.²)	W. ash No.	W. ash BA(ft.²)	W. spruce No.	W. spruce BA(ft.²)	Grey birch No.	Grey birch BA(ft.²)	Service berry No.	Service berry BA(ft.²)	T. aspen No.	T. aspen BA(ft.²)	Totals No.	Totals BA(ft.²)
DBH (in.)																
4	3	0.26	1	0.09	1	0.09	3	0.26	4	0.35	2	0.17	1	0.09	15	1.31
5	7	0.95	2	0.27			2	0.27							11	1.50
6	7	1.37	1	0.20	1	0.20									9	1.77
7	4	1.07			2	0.53									6	1.60
8					1	0.35									1	0.35
9	2	0.88	1	0.44											3	1.33
10																
11							2	1.32							2	1.32
12																
Totals	23	4.53	5	1.00	5	1.17	7	1.85	4	0.35	2	0.17	1	0.09	47	9.18
Percentages	49	49	11	11	11	13	15	20	9	4	4	2	2	1	–	–

Ironwood: *Ostrya virginiana*
White birch: *Betula papyrifera*
White ash: *Fraxinus americana*
Grey birch: *Betula populifolia*
Service berry: *Amelanchier* sp.
Trembling aspen: *Populus tremuloides*
White spruce: *Picea glauca*

Table 2. Composition, density and basal area (BA) relations in a 0.1 acre plot established on an upland-surface, Barney's River watershed, Pictou County, Nova Scotia.

Species	Ironwood No.	Ironwood BA(ft.²)	Sugar maple No.	Sugar maple BA(ft.²)	White ash No.	White ash BA(ft.²)	Beech No.	Beech BA(ft.²)	Totals No.	Totals BA(ft.²)
DBH (in.)										
4	3	0.26	9	0.79					12	1.05
5	6	0.82	4	0.55			2	0.27	12	1.64
6	8	1.57	5	0.98	5	0.98	2	0.39	20	3.92
7	5	1.34	5	1.34	1	0.27	1	0.27	12	3.22
8	1	0.35	1	0.35	7	2.44			9	3.14
9			1	0.44	3	1.33			4	1.77
10					1	0.55			1	0.55
11	1	0.66	1	0.66					2	1.32
12										
Totals	24	5.00	26	5.11	17	5.57	5	0.93	72	16.61
Percentages	33	30	36	31	24	34	7	6	–	–

Ironwood: *Ostrya virginiana*
Sugar maple: *Acer saccharum*
White ash: *Fraxinus americana*
Beech: *Fagus grandifolia*

height of 14 inches (36 cm) and heights of 55 feet (17 m). Poorly-formed, much-branched, damaged individuals of still greater diameter occasionally are encountered. Vigorous, co-dominant trees on good sites attain ages of approximately 95 years.

Tree-form in mature, forest-grown material ranges from moderately good to poor. Lean and crook in varying amounts typify many stems, although a few trees develop clear, straight boles. Individual trees may be single or multi-stemmed, often with long, round-topped crowns of varying width. Growth-habit is excurrent at the outset, commonly with numerous laterals, subsequently becoming deliquescent, but with considerable variation in branching relations from tree to tree. Branches range in size from slender to stout and in orientation from ascending to orthogonal, with the lowermost branches living or dead. Epicormic branching is very common.

ASSOCIATE SPECIES. On flood-plains, alluvial-terraces and foot-slopes ironwood occurs in association with conifers such as *Abies balsamea, Tsuga canadensis* and *Picea glauca.* Common dicotyledonous associates of ironwood in valley-bottoms and coves include *Betula papyrifera, Betula lutea, Fagus grandifolia, Ulmus americana, Acer saccharum, Acer rubrum, Acer pensylvanicum* and *Fraxinus americana. Populus balsamifera* and *Quercus rubra* var. *borealis* are infrequent bottom-land associates of ironwood.

On mid-slopes and crest-slopes the complex of species associated with ironwood is very similar to that characteristic of bottom-lands. Two minor variations involve *Ulmus americana,* which is very uncommon on valley sides, and *Picea rubens,* somewhat uncommon on bottom-lands but found more frequently with ironwood on both mid-slopes and crest-slopes. A major variant, noted only once, involves the occurrence of ironwood with *Pinus strobus* in combination with *Quercus rubra* var. *borealis* and *Tsuga canadensis* on an open, south-facing crest-slope in northeast Pictou County.

Ironwood occasionally forms local concentrations on mainland upland-surfaces at elevations below approximately 800 ft. Under these circumstances the associated species commonly are few in number and include *Fagus grandifolia, Acer saccharum* and *Fraxinus americana.* More commonly ironwood occurs as a scattered tree on mainland upland sites, in varying mixtures with *Picea glauca, Picea rubens, Tsuga canadensis, Abies balsamea, Betula lutea, Betula papyrifera, Fagus grandifolia, Fraxinus americana, Acer saccharum, Acer rubrum* and *Acer pensylvanicum.*

CROWN-CLASS AND REPRODUCTIVE RELATIONS. Ironwood occurs both as a canopy and as an understory element in the closed forests of northern Nova Scotia. In old-growth and older second-growth stands the species is rare, but has been noted in openings as well as in stands reflecting disturbance or deterioration. Under the latter circumstances the crown-class of individual ironwood stems ranges from suppressed to intermediate or isolated. In second-growth stands ironwood may be present in the canopy as co-dominant and intermediate crown-class trees, and below the canopy as suppressed, i.e. overtopped trees.

Ironwood reproduction was noted in 59 percent of the observing stations established in this study, the species occurring either in advance-growth or seedling stages, and often in both phases.

DISCUSSION

Ironwood, although apparently absent from Newfoundland (Rouleau, 1956, 1978) and Prince Edward Island (Scoggan, 1978), is widely distributed in northeastern Nova Scotia. Density commonly is low, the species occurring usually as scattered, single or multi-stemmed trees. Infrequently, considerably higher than normal densities of ironwood may be observed in north-central Nova Scotia, the species then constituting a primary element over small areas in young, second-growth, mixedwood and hardwood forests in this region.

A feature of the distribution and ecology of ironwood in the closed forests of northern Nova Scotia is its occurrence over a broad spectrum of sites in association with a large number of broad-leaved and coniferous elements. The species occurs both in the overstory and understory of young, second-growth forests in the region, and demonstrates the capacity for establishment and development under both continuous and discontinuous canopies. This distribution-occurrence-behaviour pattern is indicative of a tolerant species of substantial ecological amplitude characterized by considerable vitality.

In partially-forested areas of the region, ironwood frequently becomes established on disturbed sites. The species may be found in young, developing forests, and in thickets, hedge-rows and similar vegetation types. This capacity for establishment and continued development on disturbed sites suggests an aggressive, vigorous species adapted to a wide range of environments. The near absence

of ironwood from closed, old-growth forests may be a reflection of a modest life-span, whereas its presence in decadent or disturbed older stands suggests the capacity to invade and develop in gaps and openings.

The species appears to be in a sound condition throughout its area of occurrence in northern Nova Scotia. Flowering and fruiting materials have been observed and collected at numerous stations in the region, including several on the lower Cheticamp River watershed where the species appears to approach the northeastern limit of its range. Regeneration in both seedling and advance-growth phases is common in northern Nova Scotia; mature trees attain heights and diameters approaching those reached by individual stems in the northeastern United States (Gleason, 1952; Hough, 1907; Hui-lin Li, 1972).

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LITERATURE CITED

BULMER, R. M., AND L. S. HAWBOLDT. 1958. The forestry resouces of Nova Scotia. Department of Lands and Forests, Province of Nova Scotia, Halifax.

FERNALD, M. L. 1950. Gray's manual of botany. ed. 8. American Book Co., New York.

GLEASON, H. A. 1952. New Britton and Brown Illustrated Flora of Northeastern United States and Adjacent Canada. vol. 2. New York Botanical Garden, New York. (Second printing, slightly revised. 1958).

GRANT, D. R. 1977. Glacial style and ice limits, the Quaternary stratigraphic record, and changes of land and ocean level in the Atlantic Provinces, Canada. Geogr. Phys. Quat. 31: 247–260.

GREENIDGE, K. N. H. 1977. Silvical characteristics of sugar maple, *Acer saccharum*, in northern Cape Breton Island. Jour. Arnold. Arb. 58: 307–324.

HOUGH, R. B. 1907. Handbook of the trees of the Northern States and Canada. The Macmillan Company, New York.

LI, H. L. 1972. Trees of Pennsylvania. University of Pennsylvania Press, Philadelphia.

LITTLE, E. L. 1971. Atlas of United States trees. Vol. I. U.S. Dept. Agr. Misc. Publ. 1146. Washington. 11 pp., 202 maps, 9 overlays.

PREST, V. K., AND D. R. GRANT. 1969. Retreat of the last ice sheet from the Maritime Provinces-Gulf of St. Lawrence region. Geol. Surv. Canada Pap. 69-33: 1-15.

ROLAND, A. E., AND E. C. SMITH. 1969. The flora of Nova Scotia. Nova Scotia Museum, Halifax.

ROULEAU, E. 1956. A check-list of the vascular plants of the Province of Newfoundland. Contr. Inst. Bot. Univ. of Montreal 69: 41-106.

———. 1978. List of the vascular plants of the Province of Newfoundland (Canada). Oxen Pond Botanic Park. St. John's, Newfoundland.

SCOGGAN, H. T. 1978. The flora of Canada. pt. 3. National Museum of Natural Sciences, National Museums of Canada, Ottawa. p. 547-1115.

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